

**Scope of Work
For The
Groundwater and Watershed Modeling Elements
Of The
Integrated Watershed & Resource Conservation Program
Butte County, California**

Request:

Butte County requested that \$500,000 be earmarked in the fiscal year 2003 Energy and Water Appropriations bill, under the Bureau of Reclamation, Water and Related Resources, Central Valley Project, Sacramento River Division. These funds will be used to identify and investigate the feasibility of water supply reliability and environmental improvement options as part of an integrated watershed and resource conservation plan.

Background:

Butte County, California, an agriculturally based county, is an area of origin for water in California. The County also provides some of the most important wintering areas of the Pacific flyway, and one of the prime spring-run salmon spawning creeks in California. As water demands increase in California, many are looking to Butte County's groundwater and agricultural supplies as a new source of water. To meet its own present and future needs for local water security and reliability, while integrating these efforts with larger regional and inter-regional water supply and management projects, Butte County must develop and implement a comprehensive water supply and environmental protection program.

The Bureau of Reclamation and other federal and state agencies have for many years been involved with intensive evaluation and implementation of extensive water supply and environmental protection measures throughout Northern and Central California. Northern watersheds and areas of origin like Butte County are critical to the success of these actions. A fundamental element of Butte County's resource evaluation effort will focus on the interrelationships and mutual benefits of Butte County water resources management and watershed management with these federal, state and regional activities.

Objective:

The objective of the plan is to comprehensively study Butte County's hydrologic basin and complete an evaluation of the optimum groundwater extraction, groundwater recharge and watershed programs with the goal of developing a plan for improving overall water management. Given the importance of Butte County's agricultural economy (over \$1 billion), its environmental values, and growing population (largest population north of Sacramento County) it is essential to establish an efficient integrated water management plan that increases water supply, supports agriculture and enhances the environment.

The initial phase of this ongoing effort was completed using \$500,000 of state and local funds. An additional \$1 million of state and local funds will be used in 2003 to develop an initial integrated plan identifying potential projects. Proposed components of the plan include:

- Developing Basin Management Objectives (BMO) for various water management sub-units in Butte County. The BMO are local derived draw-down limits for groundwater in each of 18 sub-areas;
- Designing a Butte County environmental monitoring program for terrestrial vegetation types and their water demands;
- Forecasting urban and agricultural water demands for Butte County to 2023, by using the IWR-Main model for urban demands and a modified CalAg model for agricultural demands;
- Completing groundwater and drought management plans for Butte County; and
- Developing an Integrated Watershed and Resource Conservation Plan that includes ensuring Butte County has a reliable and adequate water supply, agriculture is maintained and the environment enhanced, while proposing groundwater management alternatives for Butte County.

This planning effort will help ensure that the water and related resources are managed efficiently in the future. However, a remaining need satisfied in this request. Butte County needs to enhance the data and groundwater model currently used in the Butte Groundwater Basin, while evaluating the watershed and runoff modeling needs with appropriate linkages to the groundwater model. A general scope of work for the data gathering and modeling funding requested follows.

Scope of Work

Evaluating and Upgrading the Existing Butte Basin Groundwater Model

The Butte Basin Water Users Association (BBWUA) commissioned Hydrologic Consultants, Inc., (HCI) to develop a groundwater-modeling tool for Butte Basin. The study objectives were to assemble data and assess the basin's groundwater resources, develop a quantitative understanding of groundwater system operation, and provide a tool to simulate changes caused by proposed water policy decisions. Using the computer code FEMFLOW3D (1998), HCI developed the groundwater-flow model with data for (1) groundwater system geometry and hydrology and (2) primary water inflows (recharge) and outflows (pumpage), and (3) measured groundwater levels in wells. The model solves mathematical equations to describe groundwater movement in the basin. In December 2000, the County was granted an exclusive license by BBWUA to manage the model.

As with all models, the Butte Basin groundwater model is a simplified representation of a natural system. Potential computer coding errors, data limitations, conceptual errors, and simplifying assumptions produce analytical errors. Having a credible model will be critical to gaining acceptance for potential groundwater projects or transfers from the Butte County political and public interests, as well as assuring the potential buyers of the water that they are receiving a benefit. The U.S. Geological Survey conducted an objective peer review of the computer code. A third-party review of the data considered, the conceptual groundwater system, calibration, and model performance will increase confidence in model results.

This proposed project's objectives are to (1) provide a third-party review of the model, (2) assess the County's long-term operational requirements that the model could meet, and (3) determine the County's needs for input and output capabilities. This project would eventually lead to updating the model annually as new data become available and to running groundwater-pumping scenarios to analyze the potential impacts on the basin. This information would be used to analyze and decide whether or not additional mitigation is required for the County to approve a proposed groundwater transfer. In addition, the model would be used to help advance updates of the Butte County Water Inventory and Analysis. The project elements are shown in Table 1.

TABLE 1
Estimated Project Schedule
Butte County Groundwater Modeling Project

Task	Duration	Cost (\$)
Review Data in Conceptual Model	6 months	60,000
Review Calibration and Provide Re-calibration	6 months	75,000
Improve Input and Output	1 year	50,000
Run Scenarios	1 year	55,000
Create Summary Report	3 months	15,000
Total		255,000

Enhance and Expand the Existing Watershed Modeling

This project will enhance the partnership between Butte County, the Department of Water Resources and the CALFED Bay Delta Program by providing a state of the art modeling tool that can be utilized to evaluate and monitor various watershed management conditions. The immediate benefit to the local community will be increased knowledge of their watershed, and of the consequences of various water and land use management actions on the water balances of under historical and future critical climatic conditions. However, the first deliverables of the project (Table 2) will require gathering information needed for the model in the Feather River Watershed and the Butte Groundwater Basin. Therefore, the deliverables of this project will be:

1. An important current issue is the uncertainty of the exact locations of the point and non-point recharge areas for the Butte Basin Groundwater aquifer. The initial steps will include an identification of the primary point and non-point recharge areas for the Butte Basin groundwater aquifer; an analysis of the aquifer's transmissivity; and a detailed analysis of the confined and unconfined segments of the Lower Tuscan Unit B aquifer.

2. A second issue is the effect of watershed management on the hydrology of the Feather River Watershed. For example periodic fires were once a feature of California forests and woodlands. Currently, dense stands of small diameter trees and brushy vegetation consume (evapotranspire) more water than open stands of mature trees or meadows. This results in lower water yield from the Feather River Watershed. Also, groundwater recharges streams more gradually than surface flow, thus increasing base-flow. This can also increase the useable yield of the Feather River Watershed. The initial steps will be to monitor forest treatments in Butte County to evaluate changes in runoff quantity and quality. The watershed monitoring data will be used in a watershed model to forecast future scenarios of forest management in combination with climatic changes.

TABLE 1
Estimated Project Schedule
Butte County Watershed Modeling Project

Task	Duration	Costs (\$)
Survey Potential Recharge Sites	6 months	45,000
Choose Potential Sites	3 months	20,000
Evaluate aquifer transmissivity	12 months	35,000
Create Potential Sites Report	3 months	15,000
Evaluate Links Between Models	6 months	55,000
Review Watershed Management Sites	3 months	25,000
Choose Monitoring Sites	2 months	10,000
Design monitoring program	3 months	25,000
Develop Monitoring Summary Report	3 months	20,000
Total		\$245,000

A future, longer-term issue is to implement an existing physically based watershed hydrology model, combined with an existing regional atmospheric/hydrologic model over the Feather River Basin. In order to utilize this modeling system, it must be calibrated to assess quantitatively the effect of existing water management and land use actions on the surface water and groundwater resources of the Basin under historical critical climatic conditions. Future climatic scenarios and, their impact on different groundwater pumping, surface water diversion and land use (urban development, agricultural cropping) patterns on the water resources of Butte Basin will be quantified.

These preliminary project elements are for general project planning. The scope, cost and duration of each project element will be refined further prior to contract and subcontract execution.